



An analysis of emergency tracheal intubations in critically ill patients by critical care trainees

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Abstract:	<p>Introduction: We evaluated intensive care medicine trainees' practice of emergency intubations in the United Kingdom.</p> <p>Methods: Retrospective analysis of 881 in-hospital emergency intubations over a 3-year period using an online trainee logbook.</p> <p>Results: Emergency intubations out-of-hours were less frequent than in-hours, both on weekdays and weekends. Complications occurred in 9% of cases, with no association with time of day/ day of week ($p=0.860$). Complications were associated with higher Cormack and Lehane (LC) grades($p=0.004$) and number of intubation attempts($p<0.001$), but not American Society of Anesthesiologists (ASA) grade. Capnography usage was $\geq 99\%$ in all locations except in wards (85%; $p=0.001$). Ward patients were the oldest($p<0.001$), had higher ASA grades ($p<0.001$) and lowest Glasgow Coma Scale ($p<0.001$).</p> <p>Conclusions: Complications of intubations are associated with higher CL grades and number of attempts, but not time of day/day of week. The uptake of capnography is reassuring, though there is scope for improvement on the ward.</p>

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7 **patients by critical care trainees**
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Abstract

Introduction: We evaluated intensive care medicine trainees' practice of emergency intubations in the United Kingdom.

Methods: Retrospective analysis of 881 in-hospital emergency intubations over a 3-year period using an online trainee logbook.

Results: Emergency intubations out-of-hours were less frequent than in-hours, both on weekdays and weekends. Complications occurred in 9% of cases, with no association with time of day/ day of week ($p=0.860$). Complications were associated with higher Cormack and Lehane (CL) grades($p=0.004$) and number of intubation attempts($p<0.001$), but not American Society of Anesthesiologists (ASA) grade. Capnography usage was $\geq 99\%$ in all locations except in wards (85%; $p=0.001$). Ward patients were the oldest($p<0.001$), had higher ASA grades ($p<0.001$) and lowest Glasgow Coma Scale ($p<0.001$).

Conclusions: Complications of intubations are associated with higher CL grades and number of attempts, but not time of day/day of week. The uptake of capnography is reassuring, though there is scope for improvement on the ward.

Key words: emergency; orotracheal intubations; rapid sequence induction; complications

Introduction

In-hospital emergency intubations are often performed in patients with limited physiological reserve, with limited planning, and occasionally in suboptimal locations (e.g. general wards). Over 1 million (emergency and elective) intubations are performed annually within the National Health Service (NHS) alone. Recommendations on equipment availability, rapid sequence induction (RSI), use of induction agents and neuromuscular blockade, and confirmation of intubation are available to improve the safety of emergency intubations(1).

The 4th National Airway Project (NAP4) highlighted the inherent dangers of emergency intubations (2). Poor planning of airway control was noted to correlate with poor outcomes, and is particularly relevant in emergency intubations. This ability to plan is compromised by the inherent nature of emergency intubations, but should be mitigated as much as possible by availability of all necessary equipment for intubation regardless of location, with specific mention in multiple guidelines of capnography (2, 3).

Intensive care doctors are faced with increasingly complex patients “with deranged baseline physiology and complex conditions who are disproportionately likely to experience airway difficulty, presenting challenges to airway safety in the intensive care unit (ICU)” (4). We undertook a retrospective, observational study of tracheal intubation performed by critical care trainees in United Kingdom to identify practice and complications. The primary objective was to ascertain factors associated with complications of intubations. The secondary objectives were to ascertain differences in intubation practice and complications in hours compared to out of hours, and to describe the drugs commonly used. Findings should have implications on workforce planning and airway training for intensive care trainees.

Methods

An online logbook, “MedELogbook” (www.medelogbook.com) designed for ICU junior doctors to log their referrals, transfers, procedures, and resuscitation calls was created in September

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3 2013. Individual users entered data prospectively. 3 consecutive years of data (2014- 2016)
4 was extracted from the database on 10/01/2017. All user data was anonymised.
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7 Inclusion criteria included patients aged 16 years or older who underwent emergency
8 intubations. Exclusion criteria were logs from outside the UK, and data logs from consultants.
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10 Variables used in the analyses included age, Cormack and Lehane classification of laryngeal
11 view (CL grade), American Society of Anesthesiologist (ASA) classification, complications,
12 drugs used, Glasgow coma scale (GCS), gender, location where intubation took place
13 (accident and emergency (A&E), ICU, operating theatres (OR), ward), patient category
14 (medical or surgical), time of day of intubation, use of capnography, level of supervision
15 (assisting other, directly supervised, independent, indirectly supervised, teaching a colleague,
16 and 'other'), number of attempts at intubation, and use of video laryngoscopy. Complications
17 were selected from a drop down menu of the following choices: airway trauma, aspiration of
18 gastric contents, "can't intubate can't ventilate", desaturation, failed intubation, oesophageal
19 intubation, and 'other'. It was possible to select more than one choice. Furthermore, it was
20 possible to enter free text into the logbook to provide further detail.
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32 Acknowledging that the precise working pattern may vary between ICUs, we divided each day
33 into 'daytime' (08:00-17:59) and nighttime (18:00-07:59 the next day) for both week days
34 (Monday-Friday) and weekends (Saturday-Sunday).
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41 **Missing data**

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44 It was mandatory for trainees to complete the following data fields; age, gender, location
45 where intubation took place, patient category, time of day, complications, use of capnography,
46 airway grade, ASA classification, supervision, and number of attempts. GCS prior to
47 induction, drugs used, and time taken were optional data fields.
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55 **Ethics**

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3 All users accepted the terms and conditions on registering that “all data entered will be
4 aggregated into a database for the purpose of research and audit. This may be published or
5 presented in a public domain (e.g.: conferences, journals, online). MedELogbook has the right
6 to use any data entered for this purpose. This database will not be used to interrogate the
7 data entered by individual users”. Under Section 251 of the NHS Act 2006, NHS Health
8 Research Authority ethical approval is not required as no patient identifiable information is
9 used (5). The local Research Governance & Regulatory Assurance Manager at St George’s
10 NHS Healthcare Trust, confirmed that no ethics approval was required.
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21 **Statistics**

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24 Analyses were performed using SPSS (Version 22, IBM) and graphs drawn using Microsoft
25 Excel. Differences in continuous variables between groups were compared using one-way
26 Kruskal Wallis test. Continuous variables are presented as median (interquartile range).
27 Differences in categorical variables are compared using chi-squared test. Multivariate
28 analysis using logistic regression was performed to assess variables associated with the
29 incidence of complications. Factors included in the multivariate analysis included variables
30 associated with complications on univariate analysis. A p-value of < 0.05 was taken as being
31 statistically significant for all analyses.
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42 **Results**

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45 A total of 1213 intubations were recorded on the online database between 01/01/2014 and
46 01/01/2017. A total of 331 records were excluded because they were performed outside the
47 UK (n=50), were elective procedures (n=253), and because they were paediatric cases
48 (n=28). In total 881 intubations were included in the final analysis (Table 1). Missing data
49 included GCS prior to induction (176; 20%), sedative drugs used (123; 19%), time taken (5;
50 0.5%) and video laryngoscopy use (79; 9%). **The level of training was not stated in 99**
51 **(11.2%) entries.** All other data fields were complete.
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3 Of the 881 intubations recorded, 500 (56.8%) were performed by trainees in ICM also sub-
4 specialising in anaesthesia, 214 (24.3%) by trainees in ICM (without a second specialty), 153
5 (17.4%) by trainees in ICM with an internal medicine sub-specialty, and 14 (1.6%) by other
6 (e.g. emergency medicine) trainees. Majority of entries were by specialist trainees in the first
7 years of specialist training (ST1 – ST3) (n=383; 43.5%), and in the last years of specialist
8 training (ST4- ST7) (n=285; 32.3%). Doctors who were trainees but not on a formal training
9 program accounted for 114 (12.9%) reported intubations.
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19 The median age of the patients was 59 (45-70) years, 539(61.2%) were male, and
20 242(27.5%) were emergency surgical patients. 202(22.9%) patients were ASA grade 1, 166
21 (18.8%) ASA grade 2, 292(33.1%) ASA grade 3, and 221(25.1%) ASA grade 4 (Table 1). Six
22 hundred and thirty-two (70.7%) of intubation views were grade 1, 203(23.0%) were grade 2,
23 50(5.7%) were grade 3, and only 5 (0.6%) were grade 4. The most common location for
24 intubation was ICU (n=581, 65.9%). This was followed by A&E (172; 19.5%), OR (n=63;
25 7.2%), and the wards (n=48; 5.4%). Nineteen (1.9%) intubations were excluded from this
26 data category on account of being labeled as “other” locations (radiology suite and labor
27 ward). Complications were noted in 80 of the 881 (9.1%) intubations (Table 2), with
28 desaturation being the most commonly observed (n=38). Most commonly, intubations were
29 directly supervised (363; 41.2%) or independent (n=303; 34.4%). Eighty-eight (10.0%)
30 intubations were assisted, 83 (9.4%) were under indirect supervision, 35 (4.0%) were
31 teaching others, and 9 (1.0%) was recorded as ‘other’. The number of intubations with
32 success at first attempt was greatest (n=809; 91.9%), followed by second attempt (n=61,
33 6.9%), and only 11 (1.2%) of intubations required 3 or more attempts.
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50 **Complications**

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53 Complications were noted in 80 of the 881 (9.1%) intubations (Table 2). **Most complications**
54 **occurred under direct supervision (n=37; 47.5%), followed by independent intubations (n=25;**
55 **31.3%), assisting others (n=12; 15%), and indirect supervision (n=5; 6.2%). Similar number of**
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3 complications were reported by specialist trainees in the first years of specialist training (ST1 –
4 ST3) (n=31; 38.8%), and in the last years of specialist training (ST4- ST7) (n=31; 38.8%).
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6 Doctors who were trainees but not on a formal training program accounted for 18 (22.4%)
7 reported complications.
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11 There were a disproportionate number of complications among higher CL grades ($p < 0.001$).
12 Complications were reported in 6.6% of CL grade 1 (n=623), 10.8% of grade 2 (n=203), and
13 32.0% of grade 3 airways (n=50, $p < 0.001$). There was insufficient number (n=5) of CL grade
14 4 intubations for statistical analysis. Patients with CL grade 3-4 views had a greater proportion
15 of ≥ 3 intubation attempts than patient with CL grade 1-2 views (10% vs. 2.0%, $p < 0.001$).
16 Patients with complications had a greater proportion of 3 or more attempts at intubation
17 (7.5%) compared to patients without complications (0.6%) ($p < 0.001$). There was a significant
18 association between video laryngoscopy use and complications, with a greater proportion of
19 intubations with video laryngoscopy use (19.2%) having complications compared to direct
20 laryngoscopy (8.6%) ($p = 0.004$). However, video laryngoscopy were used more often in
21 patients requiring more than one attempt at intubation (17.8% vs. 7.1%. $p < 0.001$).
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32 A greater proportion of ASA grade 3 (40.1%) and grade 4 (50.2%) compared to grade 1
33 (35.1%) and grade 2 (36.7%) intubations took place out-of-hours ($p = 0.007$). However, there
34 was no association between time of day and complications. Furthermore, a greater proportion
35 of intubations in ASA 4 patients were independent (41.6%) compared to directly supervised
36 (19.6%) ($p = 0.024$).
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42 Emergency intubations on the ward were associated with greater complication rates (14.6%)
43 compared to other locations ($< 10\%$) though this did not reach statistical significance
44 ($p = 0.065$). Age of patient, time of day and day of week, ASA grade, pre-intubation GCS,
45 medical/ surgical patients, and use of capnography had no association with complication
46 rates. The predictors of complications in multivariable logistic regression were number of
47 attempts (OR 5.95 (3.218-11.010); $p < 0.001$) and CL grade (OR=1.729 (1.186-2.521);
48 $p = 0.004$).
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Time of day and day of week

The frequency of intubations (proportion of the number of intubations recorded in the number of hours within the time period) was calculated to account for differences in the total number of hours over weekdays (120hrs), weekends (48hrs), in hours (90hrs), and out of hours (98hrs) (Table 3). There were 7.64 intubations/hour during weekday in-hours, 3.66 during weekday out-of-hours, 6.95 during weekend in-hours, and 3.71 during weekend out-of-hours.

A greater proportion of the intubations that took place overnight were independent compared to supervised (48.6% vs. 24.6%) in contrast to more intubations taking place during the day being directly supervised compared to independent (48.2% vs. 31.1%) ($p<0.001$). There was also a significant association between out-of-hour intubations and higher ASA scores ($p=0.007$). 35.1% of ASA 1 intubations were out-of-hours, compared to 50.2% of ASA 4 intubations. Despite this, time of day was not associated with complication rates ($p=0.263$) or number of intubation attempts ($p=0.344$).

There were no differences between in-hours and out-of-hours intubations and other variables (Table 3). There was no positive association between day of week and any variables.

Capnography

Capnography was used in 866 (98.3%) intubations. Capnography was used in the operating room and A+E on every occasion, in contrast to the ward or the ICU ($p<0.001$). Capnography was not used was on the ICU in 1.4% of intubations and in 14.6% of intubations on the ward. Patients on the ward were the oldest ($p<0.001$), and had a **disproportionately higher** number of ASA 4 patients (41.7%) compared other locations ($p<0.001$), and patients on the ward and in A+E had the lowest pre-intubation GCS ($p<0.001$) compared to other locations.

Use of drugs

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3 The choice of sedatives was recorded in 728 (83%) intubations. Propofol by far most common
4 induction agent used, in 550 (76%) intubations. Propofol alone was used in 253 (35%)
5 intubations, and was most commonly paired with fentanyl (n=134, 18%). Fentanyl was the
6 more popular opiate, being used in 261 (36%). Thiopentone was used in 119 (16%) cases; 58
7 (8%) of cases as the sole sedative agent.
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12 Choice of neuromuscular blocking agent was recorded in all intubations. Rocuronium was the
13 most commonly used neuromuscular blocking agent, used in 484 (66%) of cases.
14 Suxamethonium was used in 269 (37%) cases, and atracurium used in 96 (13%) cases. 19
15 (2.6%) of the intubations did not require neuromuscular blocking agents. The most popular
16 combination of neuromuscular blocking agent and sedative is rocuronium with propofol (129,
17 18%) followed by rocuronium with propofol and fentanyl (109, 15%). The use of vasopressors
18 was not recorded.
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29 **Discussion:**

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32 We present a large contemporaneous dataset of emergency intubation practices among
33 intensive care trainees in the UK. The case mix of patients is representative of UK ICU
34 demographics; the age of patients and proportion of medical/ surgical patients is similar to
35 recently published data from the Intensive care national audit and research centre (ICNARC)
36 case mix programme (6). Furthermore, the incidence of complications is in keeping with the
37 published literature (7-15).
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44 Our findings represent current practice following publication of findings and recommendations
45 of the NAP4 audit (2). A national survey conducted following the NAP4 audit found
46 improvements in practice including "improved provision of difficult airway equipment and more
47 widespread routine use of capnography" (16), and that although ICU had significant
48 improvements in practice, there was room for improvement. Whilst surveys and clinical
49 studies provide useful information, this dataset provides insight into 'real life' practice.
50 Shortfalls in airway management in the critically ill patient have a significant human and
51 financial cost (17).
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Complications

Among emergency intubations carried out by UK intensive care medicine trainees, there is an overall complication rate of 9.1%, with desaturation being the commonest complication (accounting for 47% of all complications). Complications were associated with increasing CL grade and number of attempts at intubation rather than ASA grade. Others have demonstrated the association between difficulty intubations and complications (10). If the initial attempt at intubation fails, the chance of success declines with each subsequent attempt at laryngoscopy (8, 18) and the number of attempts at intubation is associated with increasing complications (12, 13). Greater clinical experience and attending supervision of junior practitioners is associated with fewer complications (8, 13).

The **proportion** of complications was relatively high in intubations done as part of training (directly supervised). From the data available it is not possible to comment on the severity or outcomes of these complications. Furthermore, we are unable to ascertain the clinical experience of individual doctors. It is inevitable that there will be a learning curve with airway management in the critically ill patients and adequate structured training should mitigate risk (19). Training to include airway management in elective ASA 1 patients, scenario-based training with computerized patient simulator to improve mechanical skills of intubation and team leadership respectively, and cadaver-based training are effective tools in airway management training among critical care trainees (20, 21).

There are likely to be variations in reported complication rates which reflect heterogeneity in patient demographics and illness severity, level of training of doctors, and definitions of complications. For instance, the degree of desaturation or haemodynamic instability is not binary, and is contextual. Therefore, the clinician may be best placed to judge the presence or absence of any complication. In fact, desaturation and hypotension may be considered a reflection of the patients' limited physiological reserve rather than a complication associated with the intubation per se. The reported complication rate of emergency intubations is variable, ranging from 4.2% to 39% (7-15).

Time of day of intubation

Although one may presume that patients are likely to be acutely unwell at any time of the day requiring emergency intubations, we found that the frequency of emergency intubations was significantly less during weekday and weekend out-of-hours compared to in-hours. The frequency of intubations on weekdays and weekends, however, were similar. The distribution of emergency intubation timings is probably reflective of intensivist practice given the similarity with the reported literature (15, 22). This may represent improved planning and anticipation of the deteriorating of patients requiring emergency intubation; as recommended by the NAP4 audit (2).

Emergency intubations occurring out-of-hours tended to be in patients who have a higher ASA grade (a surrogate of illness severity). These intubations were more likely to be done independently, though not associated with a greater number of complications. This remains reassuring, and suggests that current workforce planning provides adequately airway-trained staffing levels round the clock. Consistent with this, emergency ICU admissions out-of hours are not associated with an increased mortality (6).

Capnography

There were disproportionately more complications associated with emergency intubations on the wards compared to other locations, though this did not reach statistical significance ($p=0.065$). This is likely to be secondary to the greater illness severity of ward patients (with ASA grade and pre-intubation GCS as surrogates of illness severity). However, almost all cases where capnography were not used were on the wards. This is of concern following NAP4 and ICS guidelines (2, 3). Although it is reassuring to see high uptake in locations where intubations are a common occurrence, the reduction of uptake on wards should not be viewed as acceptable given ease of portability of the equipment. Conversely it is reassuring to see a vast improvement in the uptake of capnography from the survey by Simpson et al

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3 (54%) (15). Further investment of training and resource is required to ensure capnography is
4 used following emergency intubations on the ward.
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10 **Use of drugs**

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12 Traditionally suxamethonium and thiopentone were the favored choices for rapid sequence
13 intubations (RSIs). Historically, anaesthetists report preference for use of thiopentone (88%)
14 compared to propofol (58%), and etomidate (54%) in RSIs (23). A recent survey of current UK
15 practice suggests a shift towards the use of propofol (with or without opiates) and rocuronium
16 to achieve adequate sedation and paralysis respectively (24). This may represent better
17 familiarity with propofol. We confirm these findings with most intubations performed with
18 propofol and only minority with thiopentone (alone or in conjunction with another induction
19 agent). The concurrent use of opiates is common, with fentanyl proving the more popular
20 option.
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30 Our data suggests that rocuronium now the most popular choice of NMB among intensivists
31 being used in over half of intubations, with suxamethonium accounting for a third. A recent
32 survey suggests that the use of rocuronium is growing, though suxamethonium is still
33 commonly used (24). We speculate that the increased use of rocuronium compared to
34 suxamethonium may be in part related to the ability to reverse the effects of rocuronium with
35 suggamadex and the perceived complications associated with suxamethonium. The use of
36 suggamadex in a timely manner with adequate efficacy during a difficult emergency intubation
37 has been described in case reports (25, 26). However, clinical trials are lacking.
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48 **Limitations and strengths of our study**

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50 Potential sources of bias in our data arise primarily from the self-reported nature of our data,
51 and data may be entered retrospectively and may be prone to recall bias of
52 events/techniques. Furthermore, we do not have data on what proportion of the total number
53 intubations performed by intensive care medicine trainees nationally this represents.
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3 Acknowledging that we are reporting perhaps a minority of all intubations in critically ill
4 patients, we do not feel these sources of bias are significant, especially given the similarity in
5 patient demographics, complication rates, and airway difficulties, with the reported literature
6 (6-15).
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11 It should also be noted that the database used to store this data is derived from intensive care
12 trainees as opposed to anaesthetics trainees and as such will be missing out on cohorts of
13 patients in hospitals where the anaesthetics teams provide out of hours airway cover, and not
14 intensive care. We lack data on a number of strategies to improve the success rates of
15 intubation including pre-oxygenation, maintenance of oxygenation, device selection, level of
16 experience of trainee, and human factors (27, 28). We do not account for the level of
17 variations in hospital staffing, training of individual trainees and clinical backgrounds. The
18 reasons for intubation, use of cricoid pressure, and use of rescue techniques are also relevant
19 information that is beyond the scope of the database.
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29 Despite these limitations, we capture useful information regarding differences in practice by
30 time of day/ day of week and location. Such data capture is important for workforce planning.
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32 Intubation practice performed by intensive care medicine trainees has not been previously
33 described to this level of detail.
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40 **Conclusion:**

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42 The incidence of clinically significant complications associated with emergency intubations is
43 not insignificant. Our data confirms the association between the CL airway grade, the number
44 of attempts at intubation and subsequently the incidence of complications. However, the lack
45 of association between complications and time of day/ day of week, or ASA grade is
46 encouraging, suggesting that adequate trained staff is available throughout the working week.
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48 Individualization of drug choices for emergency intubations may intuitively be safer, though
49 clinical trials are needed to confirm this. With oldest and sickest patients on the wards, the
50 significant reduction in usage of capnography needs to be addressed. Emergency/outreach
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3 staffing levels on weekends is crucial given the similar frequency of emergency intubations on
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For Peer Review

Abbreviations

Accident and emergency (A&E)

American Society of Anesthesiologists (ASA)

Cormack and Lehane (LC)

Glasgow Coma Scale (GCS)

Intensive care national audit and research centre (ICNARC)

Intensive care unit (ICU)

National Airway Project (NAP4)

National Health Service (NHS)

Operating theatres (OR)

Rapid sequence induction (RSI)

Declaration

Ethics approval and consent to participate: All users accepted the terms and conditions on registering that “all data entered will be aggregated into a database for the purpose of research and audit. This may be published or presented in a public domain (e.g.: conferences, journals, online). MedELogbook has the right to use any data entered for this purpose. This database will not be used to interrogate the data entered by individual users”. Under Section 251 of the National health service (NHS) Act 2006, NHS Health Research Authority ethical approval is not required as no patient identifiable information is used (5). The local Research Governance & Regulatory Assurance Manager at St George’s NHS Healthcare Trust, confirmed that no ethics approval was required.

Consent for publication: Not applicable

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3 **Availability of data and material:** The datasets used and/or analysed during the current
4 study are available from the corresponding author on reasonable request.
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7 **Competing interests:** N.A and K.A have designed and created the online database. NA and
8 KA own the database and have access to the data. At the time of writing, there is no financial
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10
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17 and KA conceived the study idea and designed the study. KA extracted the data from the
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19 drafted the manuscript. All authors critically revised the manuscript for important intellectual
20 content. All authors had full access to all of the data in the study, take responsibility for the
21 integrity of the data and the accuracy of the data analysis. BJP and MC supervised the
22 project, participated in the data analysis and interpretation, in writing and editing the
23 manuscript. All authors read and approved the final manuscript
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For Peer Review

Tables

Age (years)	59 (45-70)
Gender	
Male	539 (61.2%)
Female	342 (38.8%)
Complications	
Yes	80 (9.1%)
No	801 (90.9%)
Category	
Medical	639 (72.5%)
Surgical	242 (27.5%)
ASA Grade	
1	202 (22.9%)
2	166 (18.8%)
3	292 (33.1%)
4	221 (25.1%)
CL Grade	
1	632 (70.7%)
2	203 (23.0%)
3	50.7(5.7%)
4	5 (0.6%)
Location	
A&E	172 (19.5%)
Intensive care unit	581 (65.9%)
Theatres	63 (7.2%)
Ward	48 (5.4%)
Time	
Weekday in hours	382 (43.4%)
Weekday out of hours	256 (29.1%)
Weekend in hours	139 (15.8%)
Weekend out of hours	104 (11.8%)
Capnography	
Yes	866 (98.3%)
No	15 (1.7%)
Video laryngoscope	
Yes	73 (8.3%)
No	808 (91.7%)
Supervision	
Directly supervised	363 (41.2)

Independent	303 (34.4%)
Assisted by other	88 (10.0%)
Under indirect supervision	83 (9.4%)
Teaching others	35 (4.0%)
'Other'	9 (1.0%)
Attempts	
1	809 (91.8%)
2	61 (6.9%)
≥3	11 (1.2%)

Table 1: Details of patient demographics and intubation procedure

(A+E: Accident and emergency department; ASA: American association of anaesthesiologist; CL: Cormack and Lehane classification of laryngeal view)

Complications:	Number
Desaturation	38 (47.5%)
Failed intubation requiring senior input/ Oesophageal intubation	19 (23.8%)
Aspiration of gastric contents	8 (10.0%)
Cardiac arrest	5 (6.3%)
Hypotension	4 (5.0%)
Other (3 equipment failure, 2 traumatic intubation, 1 inadequate paralysis)	6 (7.5%)
Total	80

Table 2. Complications associated with emergency tracheal intubation

	In hours	Out-of-hours	Total	P value
Category				0.070
Medical	354 (67.9%)	260 (72.2%)	614 (69.7%)	
Surgical	147 (28.2%)	95 (26.4%)	242 (27.5%)	
Gender				0.098
Male	307 (58.9%)	232 (64.4%)	539 (61.2%)	
Female	214 (41.1%)	128 (35.6%)	342 (38.8%)	
Complications				0.263
No	469 (90.0%)	332 (92.2%)	801 (90.9%)	
Yes	52 (10.0%)	28 (7.8%)	80 (9.1%)	
Location				<0.001
A+E	100 (19.2%)	72 (20.0%)	172 (19.5%)	
Intensive care unit	331 (63.5%)	250 (69.4%)	581 (65.9%)	
Operating theatre	51 (9.98%)	12 (3.3%)	63 (7.2%)	
Ward	24 (4.6%)	24 (6.7%)	48 (5.4%)	
Other	15 (2.9%)	2 (0.6%)	17 (1.9%)	
Time taken				0.637
<20min	349 (67.2%)	242 (67.8%)	591 (67.5%)	
20-40min	102 (19.7%)	68 (19.0%)	170 (19.4%)	

40-60min	47 (9.1%)	27 (7.6%)	74 (8.4%)	
> 60min	21 (4.0%)	20 (5.6%)	41 (4.7%)	
ASA grade				0.007
1	131 (25.2%)	71 (19.7%)	202 (22.9%)	
2	105 (20.2%)	61 (16.9%)	166 (18.8%)	
3	175 (33.6%)	117 (32.5%)	292 (33.1%)	
4	110 (21.1%)	111 (30.8%)	221 (25.1%)	
Age (years)	59.0 (45.0-70.0)	59.0 (45.0-70.5)	59(45-70)	0.749
Glasgow coma score	11 (6-14)	10 (6-14)	10 (6-14)	0.292
CL Grade				0.520
1	360 (69.1%)	263 (73.1%)	623 (70.7%)	
2	126 (24.2%)	77 (24.1%)	203 (23.0%)	
3	31 (6.0%)	19 (5.3%)	50 (5.7%)	
4	4 (0.8%)	1 (0.3%)	5 (0.6%)	
Capnography use				0.322
Yes	514 (98.7%)	352 (97.8%)	866 (98.3%)	
No	7 (1.3%)	8 (2.2%)	15 (1.7%)	
Attempts at intubation				0.344
1	478 (91.7%)	331 (91.9%)	809 (91.9%)	
2	34 (6.5%)	27 (7.5%)	61 (6.9%)	
≥3	9 (1.7%)	2 (0.6%)	11 (1.2%)	

Supervision				<0.001
Assisting other	39 (10.8%)	49 (9.4%)	88 (10.0%)	
Independent	112 (31.1%)	251 (48.2%)	363 (41.2%)	
Directly supervised	175 (48.6%)	128 (24.6%)	3030 (34.4%)	
Indirect supervision	20 (5.6%)	63 (12.1%)	83 (9.4%)	
Teaching other	11 (3.1%)	24 (4.6%)	35 (4.0%)	
Other	3 (0.8%)	6 (1.2%)	9 (1.0%)	
Video laryngoscopy				0.397
Yes				
No	46 (9.8%)	27 (8.1%)	73 (9.1%)	
	422 (90.2%)	307 (91.9%)	729 (90.9%)	

Table 3: Characteristics of emergency intubations by time of day.

(A+E: Accident and emergency department; ASA: American association of anesthesiologist; CL: Cormack and Lehane classification of laryngeal view) p-values are for comparison of proportions between in- and out- of hours.